

are subjected to the definite temperatures of 55° , 70° , and 85° of Fahrenheit in succession.

In Mr. Hartnup's report to the Mersey Docks and Harbour Board for the year 1870, it will be seen that, for 381 chronometers tested in this way, the mean of all the greatest differences of daily rate between any two weeks is $2^{\text{s}}.14$ and that $1^{\text{s}}.61$, or about three-fourths, of this appears to be due to error in thermal adjustment.

In order to render the information thus obtained available for comparison the rotation number, showing the order in which the instrument was received at the Observatory, has been supplied with each certificate of test. At the end of each year an abstract of the rate of each chronometer with its rotation number is published so that by preserving this number the owner of any chronometer tested at the Observatory may, by means of the printed abstracts, compare its performance with that of any other instrument, or with the average of all tested during the year, and may immediately see whether the regularity of performance was better or worse than the average.

The Liverpool Observatory was not originally supplied with self-registering meteorological instruments, but their erection was subsequently urged upon the authorities of Liverpool by merchants and scientific gentlemen resident in the town and neighbourhood. Applications are frequently made for extracts from meteorological records months and even years subsequent to the date on which the various phenomena have been recorded, and a table of results for the year 1870, which is intended to supply the information generally applied for, has been published in the Report for that year.

The testing of nautical instruments, and the taking and reducing of meteorological observations, have so much occupied the time of Mr. Hartnup during the past two years, that with but one assistant he has been able to do but very little work with the equatoreal.

Stonyhurst Observatory.

The chief improvement since last year is the adaptation of a photographic apparatus to the Equatoreal, with the view of obtaining enlarged pictures of sun-spots. Images of various sizes were photographed during the summer months, and the scale finally adopted was that of $17\frac{1}{2}$ inches to the solar diameter. Mr. Pateson, the photographer of the Preston Town Council, most kindly aided in making the necessary arrangements. The end proposed is to procure a series of photographic records of the daily, or even more rapid, changes in any remarkable spot, or group of spots.

Connected with the magnetic department of this observatory a survey of Belgium was undertaken during the months of August and September. The magnetic declination, dip, and

horizontal force, were observed at about 20 stations, and these observations are at present in course of reduction.

Kew Observatory.

The photographic solar observations have proceeded during the last year with great regularity, under the superintendence of Mr. De La Rue, and have been so much favoured by the weather, that on 226 days 381 photograms have been taken, a result far exceeding that of any previous year. The reductions and investigations necessary for the intended determination of the Sun's elements have progressed vigorously, and are now completed up to the end of the year 1869, while two independent papers, one having reference to a distinct law in the form of the sun-spot curve, and published by the Royal Society; the other, giving further evidence of the interplanetary relations of the Sun as shown by its activity, and handed in for publication,—have also been prepared during that time. The special summary for last year will be laid before the Royal Astronomical Society very shortly.

The past year is the last in the ten-yearly period during which the Photoheliograph at Kew has been at work, and within a very few days the continuous photographic record of the Sun's disk will in this country draw to a close. How great a loss this is for astronomical science, especially at the present time when the inquiries into the physical nature of the Sun form so prominent a part in the activity of astronomers, will be seen by the statement that during these ten years no less than 2778 solar photograms have been taken, preserving almost for all time the most faithful record of fleeting phenomena, still surrounded with profound mystery and great interest, and still promising the most surprising disclosures of the widest bearing. About twenty papers, embodying laborious investigations and discussions, have been communicated during that time to the Royal Society and the Royal Astronomical Society, by the observers engaged in the Kew solar researches, and have been published.

The completion of the reductions for the years 1870 and 1871, as well as the final discussion of the whole series, will be completed at Mr. De La Rue's expense, and will take about one year and a half. The paper containing this last instalment of the work will, it is confidently expected, be a conclusive proof in itself that solar-eye observations can no longer compete with photographic in the absolute reliability of the facts deduced. Concurrently with the discussion of the Sun-spots, the relative amount of faculæ will be measured in the Kew pictures, as there is reason to think that important conclusions may be drawn in regard of solar activity by a study of the faculæ. All the Kew pictures may not be available for this purpose, but in future, pictures can be taken in which the faculæ will be most carefully defined, by so regulating the exposure of the photograph that these entities may be rendered very